Technical Memorandum

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To:	Mike Peebles, PE
From:	Joshua Owens, PE; Karina Nordahl, PE; Rose Horton, PE
Copies:	File
Date:	January 4, 2017
Subject:	Lolich and Bellairs Existing Drainages
Project No.:	17849

Introduction

The Ridge at South Cooper Mountain subdivision project (Lolich-Bellairs property) is a proposed residential development in the City of Beaverton, with stormwater jurisdiction through Clean Water Services (CWS). Two existing drainages flow through the property.

The purpose of this memorandum is to document hydrologic and hydraulic analyses carried out to determine Base Flood Elevations (BFE's) and map the flood hazard area subject to inundation by the 1% annual chance flood (100-year flood) on the property as required by the City of Beaverton Development Code.

Hydrology

Study Area

The study area is located in the City of Beaverton, Washington County, Oregon. The drainage basins were delineated in AutoCAD using survey information and LiDAR contours from Dogami. Soils data was intersected with the delineated basins seen in Figure 1.

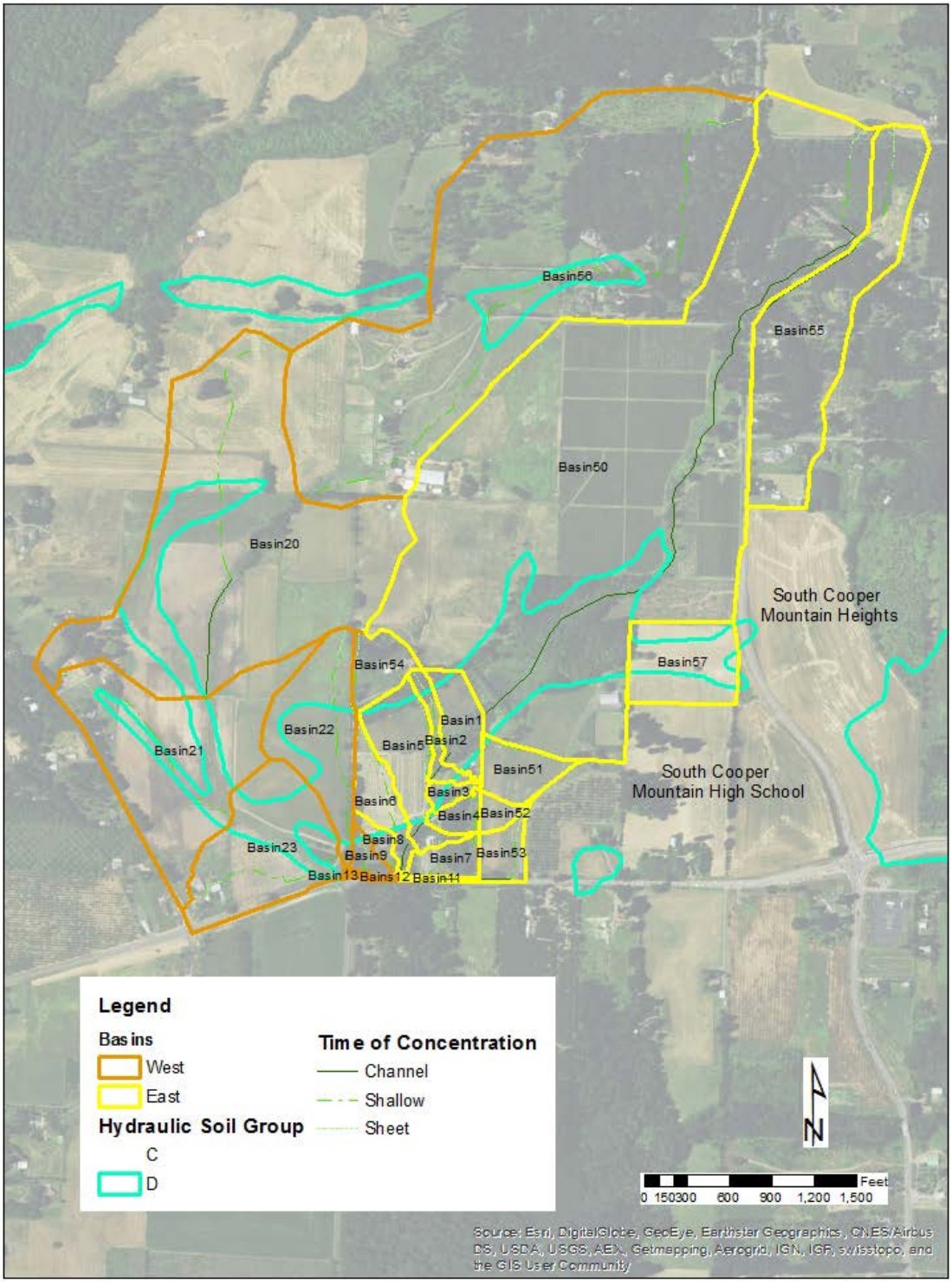


Figure 1. Drainage Basins

An unnamed drainage ditch intersects the property in the northeast corner and flows south to a ditch along the north side of SW Scholls Ferry before discharging through a 36-inch culvert under SW Scholls Ferry Road. The eastern drainage ditch drains approximately 253 acres of mostly agricultural fields, undeveloped grassed and wooded areas with few homes and one housing development before it crosses SW Scholls Ferry Road. The roadside ditch also receives flow from

another unnamed drainage to the west. The western drainage ditch drains approximately 246 acres of mostly agricultural fields, undeveloped grassed and wooded areas with few homes. The eastern drainage ditch culminates in an irrigation pond which outfalls to a vegetated drainage ditch on the west side of Strobel Road before crossing Strobel Road in a 48-inch culvert to enter the SW Scholls Ferry Road ditch. This western portion of roadside ditch discharges to a 36-inch culvert under SW Scholls Ferry Road. The ditch along SW Scholls Ferry Road is divided by a gravel driveway and connected by 10-inch culvert.

Soils are categorized by the National Resource Conservation Service (NRCS) as hydrologic soil group types C and D, which consist of silt loams (See Appendix A). These soils generally exhibit moderate to low infiltration rates and relatively high runoff rates. The subbasins were further divided by soil group and an impervious percentage was assigned to each based on existing land use as summarized in table 1.

Table 1: Basin Areas

Subbasin Name	Hydrologic Soil Group	Percent Impervious	Impervious Area (ac)	Pervious Area (ac)
Basin1	C	10	0.076	0.680
Basin1	D	10	0.394	3.547
Basin2	C	5	0.034	0.645
Basin2	D	5	0.076	1.448
Basin3	C	5	0.034	0.644
Basin3	D	5	0.023	0.429
Basin4	C	5	0.090	1.715
Basin4	D	5	0.002	0.041
Basin5	C	10	0.190	1.710
Basin5	D	10	0.634	5.702
Basin6	C	10	0.082	0.740
Basin6	D	10	0.377	3.395
Basin7	C	16	0.432	2.267
Basin8	C	5	0.039	0.746
Basin8	D	5	0.024	0.455
Basin11	C	75	0.298	0.099
Basin50	C	5	7.007	133.130
Basin50	D	5	1.021	19.391
Basin51	C	5	0.225	4.273
Basin51	D	5	0.004	0.067
Basin52	C	5	0.070	1.337
Basin53	C	10	0.294	2.644
Basin54	C	10	0.421	3.787
Basin54	D	10	0.000	0.003
Basin55	C	10	2.928	26.354
Basin57 (Basin14)*			0.3	0.9
Basin57 (Basin15)*			0.1	5.7

Table 1: Basin Areas				
Subbasin Name	Hydrologic Soil Group	Percent Impervious	Impervious Area (ac)	Pervious Area (ac)
OFF5*			0	0.8
East**			**24.18**	**228.20**
Basin9	C	2	0.023	1.109
Basin9	D	2	0.004	0.174
Basin10	C	0	0.000	0.097
Basin12	C	60	0.065	0.043
Basin13	C	60	0.064	0.043
Basin20	C	2	1.305	63.941
Basin20	D	2	0.184	8.998
Basin21	C	10	2.685	24.169
Basin21	D	10	0.508	4.569
Basin22	C	2	0.144	7.066
Basin22	D	2	0.137	6.720
Basin23	C	10	1.305	11.746
Basin23	D	10	0.557	5.017
Basin56	C	10	10.034	90.307
Basin56	D	10	0.534	4.806
West			**17.55**	**228.81**

* Areas from SCM High School Preliminary Draft Stormwater Management Plan (HHPR, 2015)
** Includes area from South Cooper Mountain Heights

Peak runoff rates generated from the basins were calculated using the Santa Barbara Urban Hydrograph (SBUH) method in HydroCAD v10.0. The un-detained hydrograph from the portion of the South Cooper Mountain Heights development that drains under SW 175th Avenue was included in the HydroCAD model and the 24-inch pipe from the existing public storm water pond on the High School site was allowed to limit the discharge rate from these offsite areas.

Precipitation depths for this project site, listed in Table 2, were obtained from the COB *Engineering Design Manual* and used to calculate site rainfall and runoff rates based on the NRCS Type 1A rainfall distribution.

Table 2: City of Beaverton Precipitation Depths	
Recurrence Interval	Precipitation Depth (in)
2-Year	2.50
10-Year	3.50
25-Year	4.00
100-Year	4.50

Based on the existing land use and hydrologic soil groups, curve numbers (CN) were applied to the subbasins. A higher CN indicated more potential for rainfall runoff. Table 3 provides a summary of the runoff curve numbers.

Table 3: Runoff Curve Numbers		
Cover Type	Hydrologic Soil Group	Curve Number
Pavement	C	98
Pavement	D	98
Woods/grass comb., Good	D	79
Woods/grass comb., Good	C	72

A time of concentration, which is the time for runoff to travel from the hydraulically most distant point to the point of interest, was calculated for the basin. The time of concentration includes overland flow, sheet flow, and shallow concentrated flow and is influenced by surface roughness, flow patterns and slope estimated from aerial imagery and LiDAR contours. Time of concentration values for each contributing drainage basin under existing conditions were calculated using the method provided by the SCS Technical Release 55 (SCS 1986), see Appendix A. The minimum allowable time of concentration for any drainage basin is five minutes.

Hydraulics

Modeling Approach

The analysis for the eastern drainage ditch extends from the Lolich-Bellairs property line in the north to the channel downstream of the culvert under SW Scholls Ferry Road. The hydraulic analysis for the western drainage ditch extends from the Bierly property boundary in the north to the SW Scholls Ferry Road crossing just south for the Lolich-Bellairs property line.

The hydraulic analysis was only carried out for the one-percent-annual chance flood peak (100-yr event) with no floodway analysis. The U.S. Army Corps of Engineers HEC-RAS software was utilized to model the mapped floodplain through the study area. HEC-RAS was utilized to model this reach because it is the most common one-dimensional (1-D) model utilized for the National Flood Insurance Program.

Flow from the two drainage ways joins on the Lolich-Bellairs property in the roadside ditch along the north side of SW Scholls Ferry Road. An unsteady hydraulic model was set up using a two-dimensional (2-D) mesh to capture the flow exchange between the two drainage ways. The ditch is bisected by an existing driveway and connected with a 10-inch concrete culvert.

The two drainages were evaluated in a separate steady state 1-D HEC-RAS model.

The basis of the geometric data for the hydraulic modeling for the east drainage is the detailed topographic survey data collected specifically for this study. The western channel cross sections were created from survey points with the exception of the sections 105a and b as survey data was not available. In areas where Survey data was not available and for the overbank areas along the western

ditch, LiDAR data was used. Survey elevations are NGVD29 based on Washington County benchmark #107.

Manning's n values were based on field observations and engineering judgment. Main channel Manning's n values for the project reach ranged from 0.04 to 0.08. Table 4 summarizes the selected values.

Table 4. Manning's n values	
Description	Selected n Value
Main Channel	
Earth channel with tall grass	0.04
Earth channel with long dense weeds	0.06
Earth winding channel with long dense weeds	0.08

Contraction and expansion coefficients in the HEC-RAS model were set to 0.1/0.3 for all cross sections outside of the contraction/expansion zone in the vicinity of the culverts and bridge. The values were increased to 0.3/0.5 to account for contraction and expansion of flow into and downstream of the culverts and bridge.

Ineffective flow areas were used in the HEC-RAS model to properly model the conveyance (distribution of flow) for the cross sections along the modeled reach. This includes constraining the flow for the contraction and expansion zones upstream and downstream of the culverts and bridge.

Interpolated cross sections were added to the HEC-RAS model to improve the solution of the standard-step backwater calculations. Without the interpolated cross sections there were multiple locations in this reach with computed critical depth. The interpolated cross sections reduced the number of critical depth locations.

Input discharges to the HEC-RAS model were derived from the hydrographs from the HydroCAD model and are summarized in Appendix A.

Table 5. Flow Data				
Drainage	Reach	Cross-Section	Contributing Basins	Flow Rate (cfs)
East Channel	Reach 1	1447	Basins 1, 50, 55, 57, OFF5, SCM Heights	63.53
East Channel	Reach 1	1278	Basin 51	65.09
East Channel	Reach 1	997	Basin 2	65.89
East Channel	Reach 1	825	Basins 3, 54	67.64
East Channel	Reach 1	605	Basins 4, 52	68.73
East Channel	Reach 1	510	Basins 5	71.92
East Channel	Reach 1	343	Basins 6, 7, 8	75.70
East Channel	Reach 1	159	Basins 11, 53	77.50
West Channel	Reach 1	3858	Basins 20, 56	50.03

West Channel	Reach 1	2136	Basin 21	60.65
West Channel	Reach 1	1238	Basin 23	67.48
West Channel	Reach 1	327	Basins 9, 10, 12, 13, 22	72.98

The downstream boundary condition for the 2-D model were culvert rating curves developed in HY8 version3.7 was based on normal depth for the downstream slope, see Appendix B.

Model Results and Mapping

Results of the hydraulic analysis were used to develop BFE's along the study reach and to map the 100-year floodplain (SFHA) per FEMA standards. The computed 100-year water surface profile along the east and west drainage ditches are shown in Figures 2 and 3, respectively. The distances on the x-axis correspond to the stationing on the attached floodplain maps. The analysis shows the 100-year floodplain is constrained to a path along the channel in the eastern drainage ditch on the Lolich-Bellairs property. In the western drainage on the Bierly property, the 100-year floodplain is constrained to the channel in the upper reach and widens over the existing irrigation pond in the southeast corner of the property. The floodplain widens on the Lolich-Bellairs property where the two drainages enter the ditch parallel to SW Scholls Ferry Road before crossing under the road. See the floodplain boundary in the attached maps.

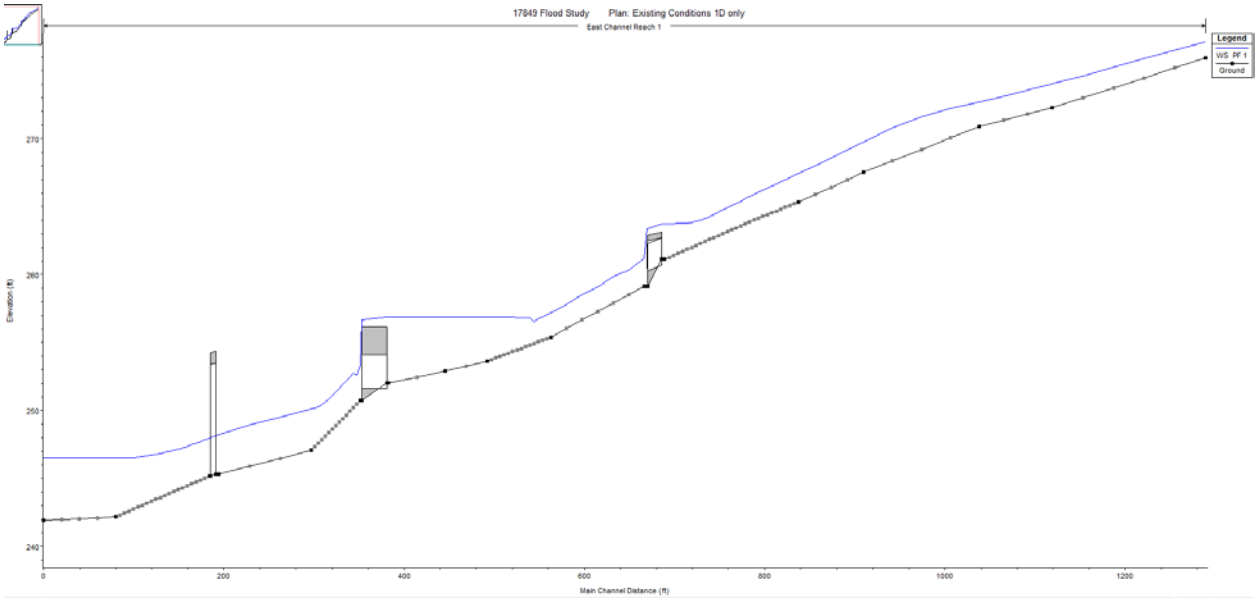


Figure 2 East Drainage channel bed and computed 100-yr water surface profile

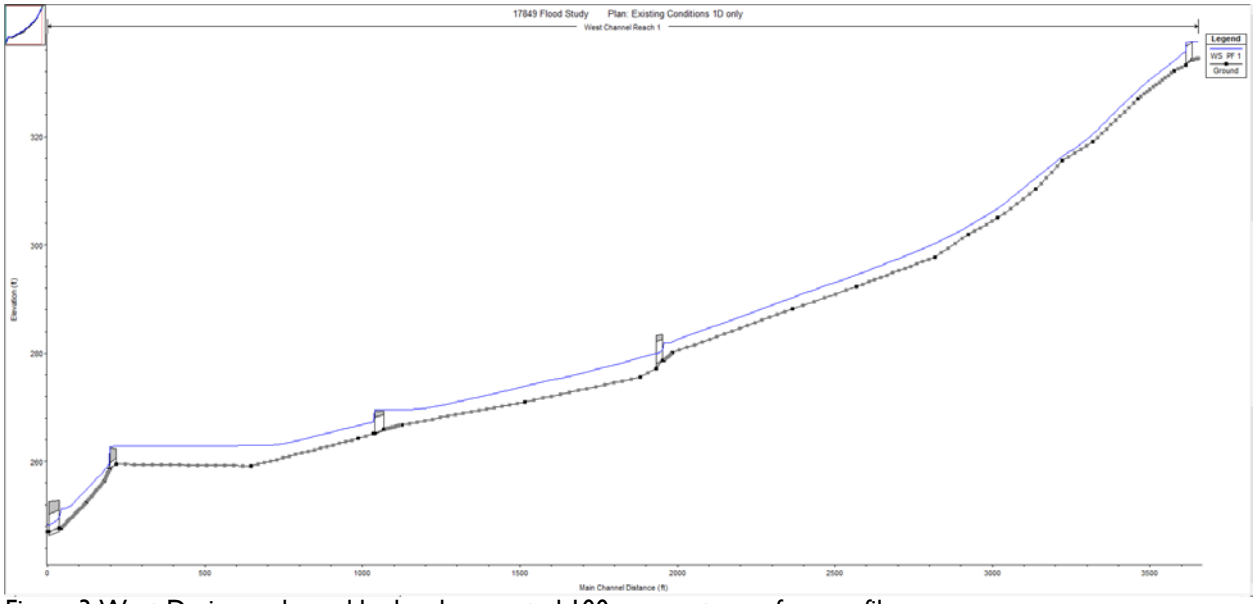


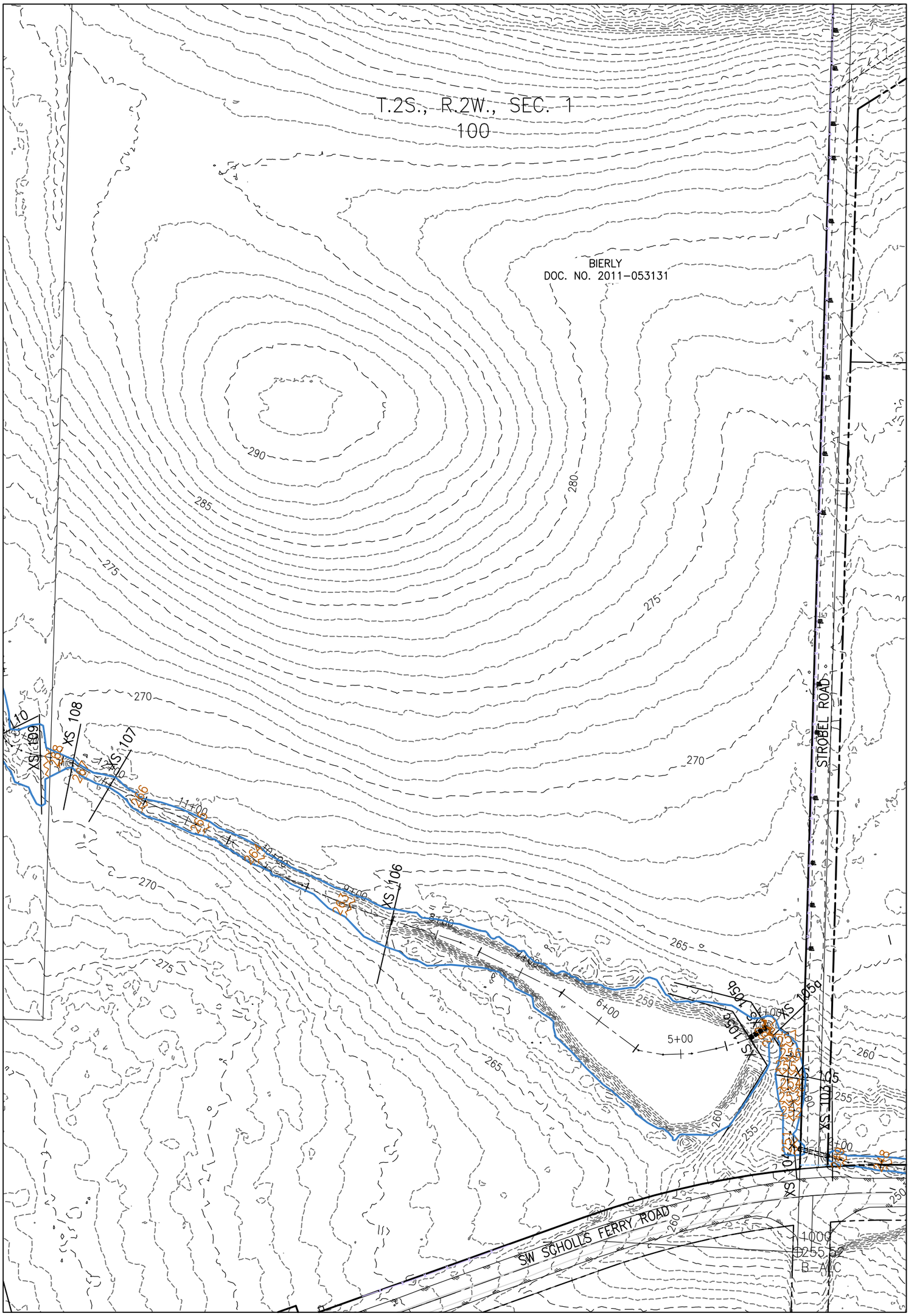
Figure 3 West Drainage channel bed and computed 100-year water surface profile

References

HHPR, 2015. *South Cooper Mountain Highschool Draft Stormwater Management Report*, Harper Houf Peterson Righellis Inc., January 2015.

Otak, 2015. *South Cooper Mountain Heights Preliminary Drainage Report*, Otak, Inc., December 2, 2015.

Attachments — Drainage Floodplain Maps



Bierly (West Channel) Floodplain

100' 0' 100' 200'

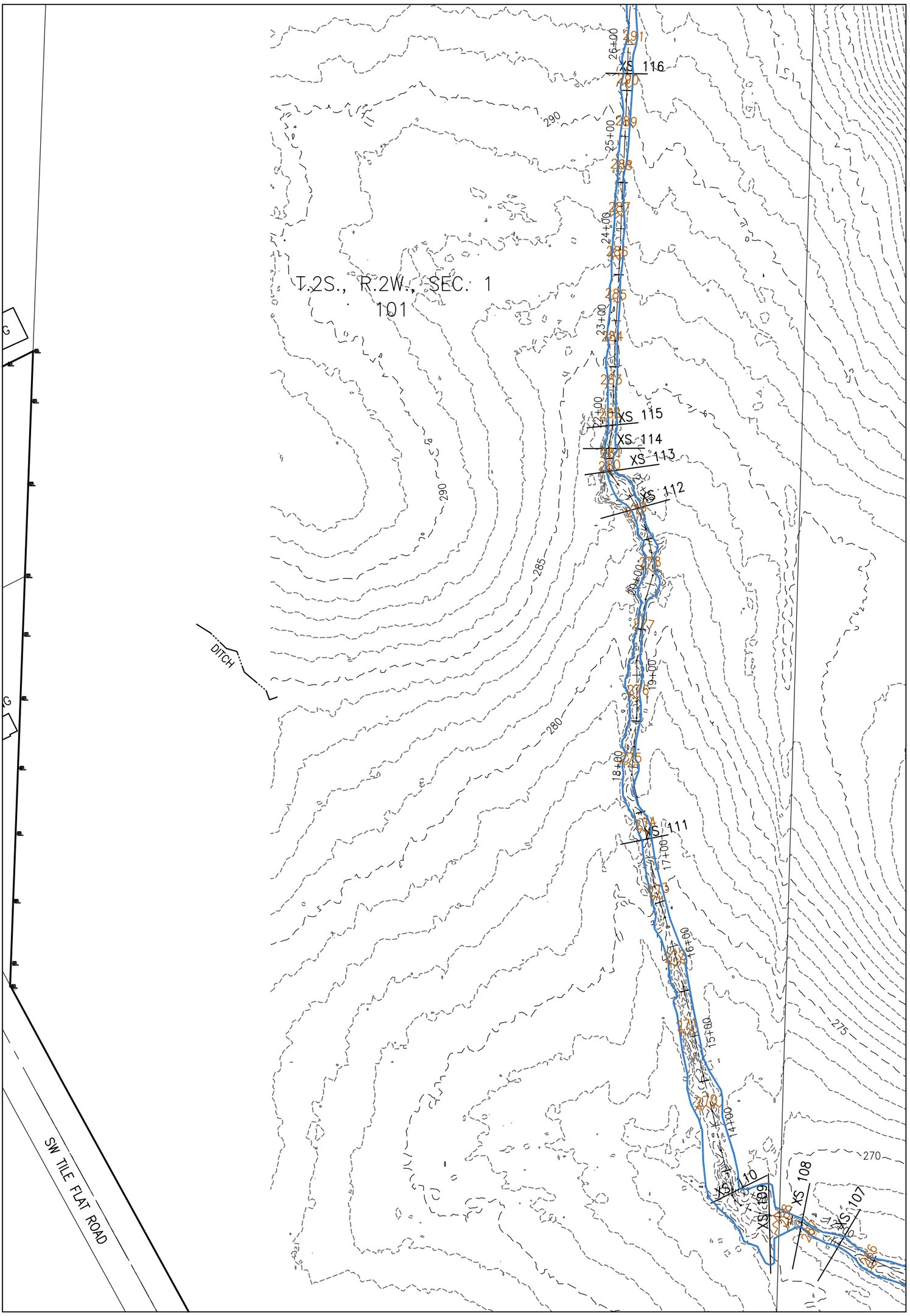
SCALE IN FEET

LEGEND

Cross Section — XS 19

Floodplain Limits

Base Flood Elevation — 277



Bierly (West Channel) Floodplain

100' 0' 100' 200'

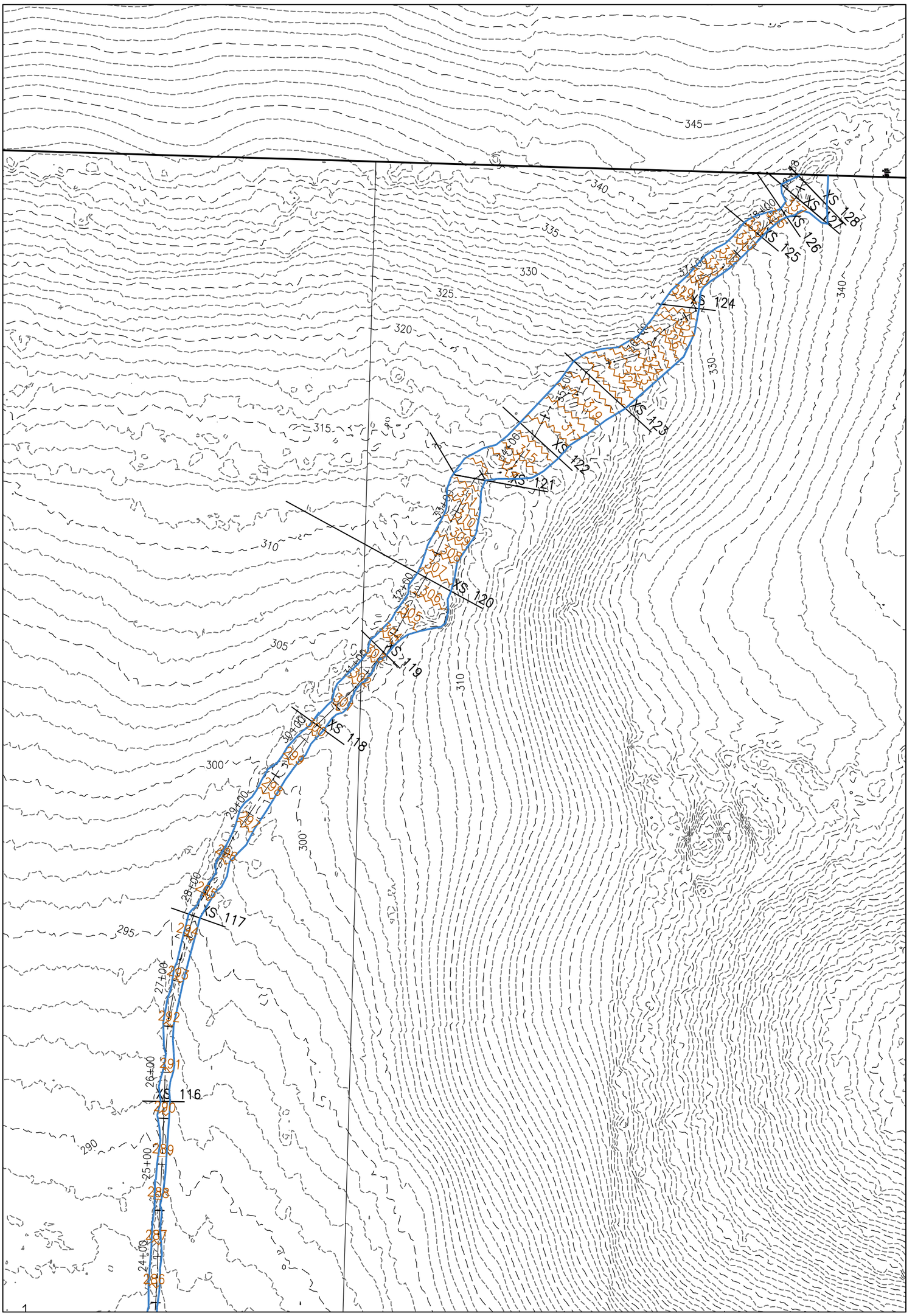
SCALE IN FEET

LEGEND

Cross Section XS 19

Floodplain Limits

Base Flood Elevation 277



Bierly (West Channel) Floodplain

100' 0' 100' 200'

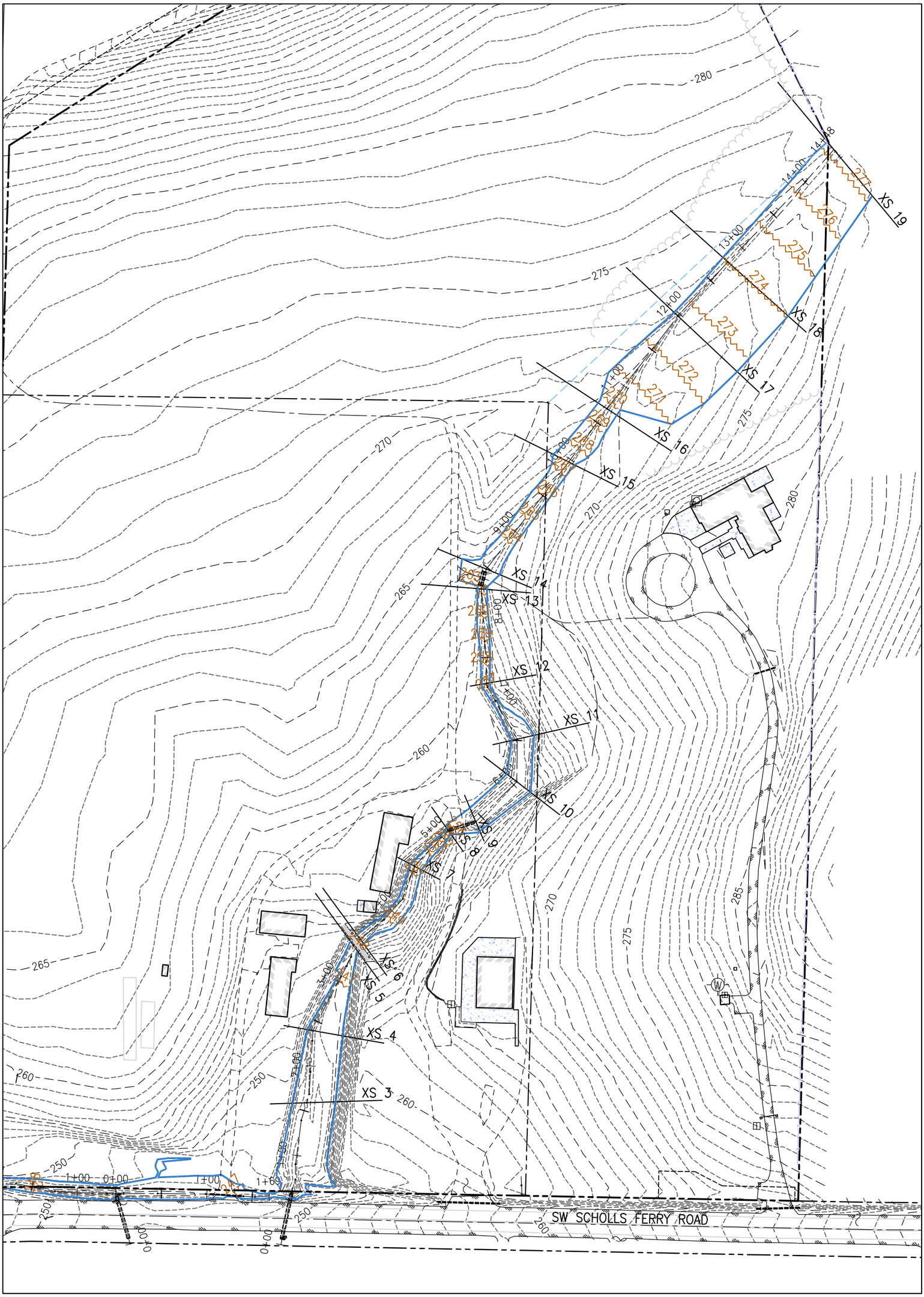
SCALE IN FEET

LEGEND

Cross Section — XS 19

Floodplain Limits

Base Flood Elevation — 277



Lolich–Bellairs (East Channel) Floodplain

100' 0' 100' 200'

SCALE IN FEET

LEGEND

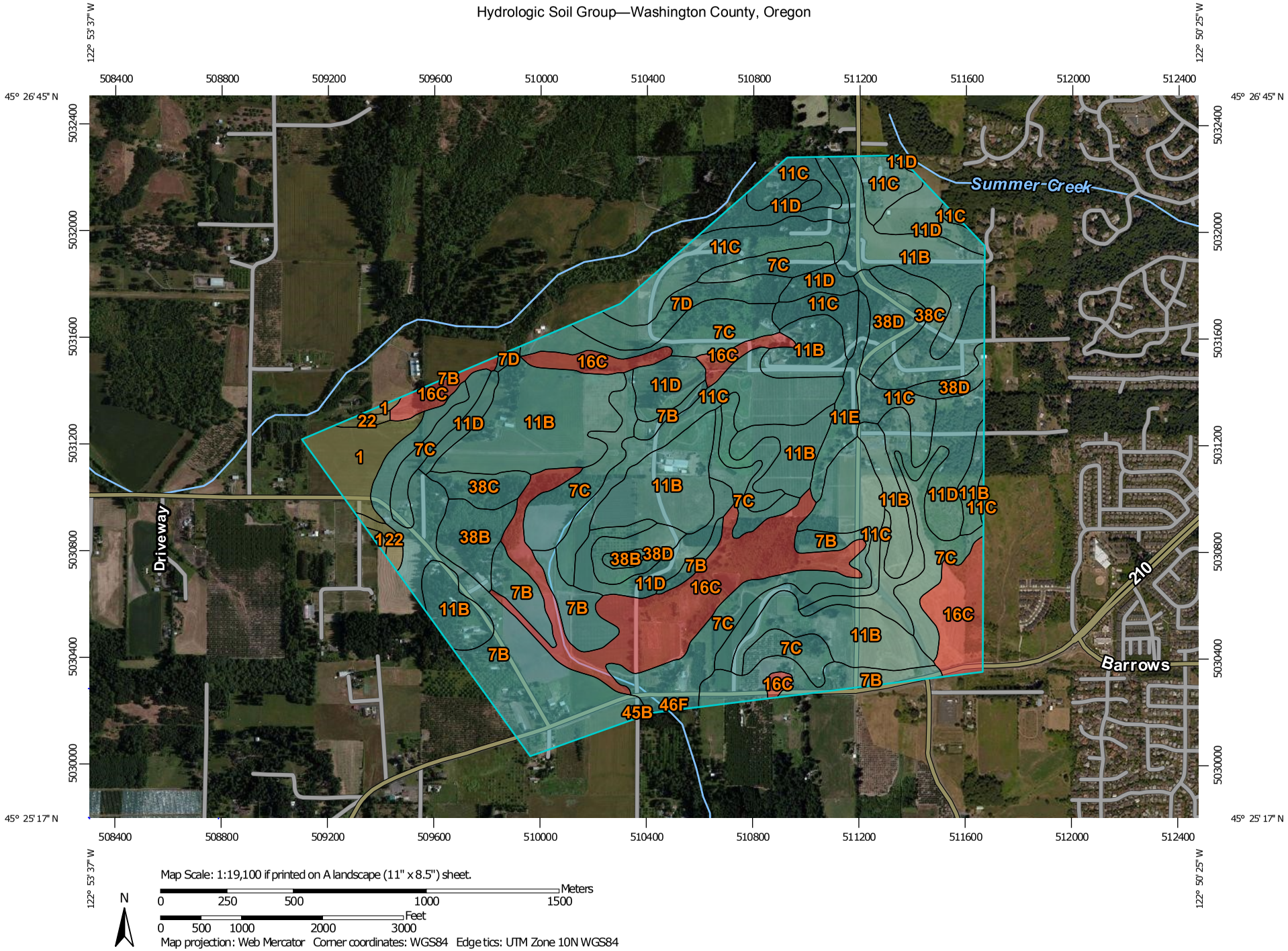
Cross Section — XS 19

Floodplain Limits

Base Flood Elevation — 277

Appendix A—Hydrology

Hydrologic Soil Group—Washington County, Oregon



Map Scale: 1:19,100 if printed on A landscape (11" x 8.5") sheet.

N

0 250 500 1000 1500 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 13, Sep 18, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—Aug 23, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Washington County, Oregon (OR067)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1	Aloha silt loam	C/D	20.5	2.2%
7B	Cascade silt loam, 3 to 7 percent slopes	C	119.4	12.9%
7C	Cascade silt loam, 7 to 12 percent slopes	C	124.5	13.5%
7D	Cascade silt loam, 12 to 20 percent slopes	C	18.9	2.0%
11B	Cornelius and Kinton silt loams, 2 to 7 percent slopes	C	195.3	21.1%
11C	Cornelius and Kinton silt loams, 7 to 12 percent slopes	C	130.1	14.1%
11D	Cornelius and Kinton silt loams, 12 to 20 percent slopes	C	109.0	11.8%
11E	Cornelius and Kinton silt loams, 20 to 30 percent slopes	C	11.8	1.3%
16C	Delena silt loam, 3 to 12 percent slopes	D	111.0	12.0%
22	Huberly silt loam	C/D	4.7	0.5%
38B	Saum silt loam, 2 to 7 percent slopes	C	17.0	1.8%
38C	Saum silt loam, 7 to 12 percent slopes	C	33.4	3.6%
38D	Saum silt loam, 12 to 20 percent slopes	C	28.5	3.1%
45B	Woodburn silt loam, 3 to 7 percent slopes	C	1.0	0.1%
46F	Xerochrepts and Haploxerolls, very steep	B	0.4	0.0%
Totals for Area of Interest			**925.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

South Cooper Mountain High School
Draft Stormwater Management Report

Prepared For:
The City of Beaverton
Clean Water Services
and
National Marine Fisheries Service

Prepared By:
Angela Martinec, P.E. – Civil Engineer

January 2015

Harper Houf Peterson Righellis Inc.
ENGINEERS ♦ PLANNERS
LANDSCAPE ARCHITECTS ♦ SURVEYORS

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P:\BOR (Boora Architects)\BOR-13 (BSD New HS)\BOR13-DWGS\STORMWATER\ BOR13-SWM Basins.dwg

JOB NO. BOR-13

SHEET NO. 2

DATE	NO.	DESCRIPTION
		REVISIONS

DESIGNED: AMM
DRAWN: AMM
CHECKED: HHPR
DATE: JANUARY 2015

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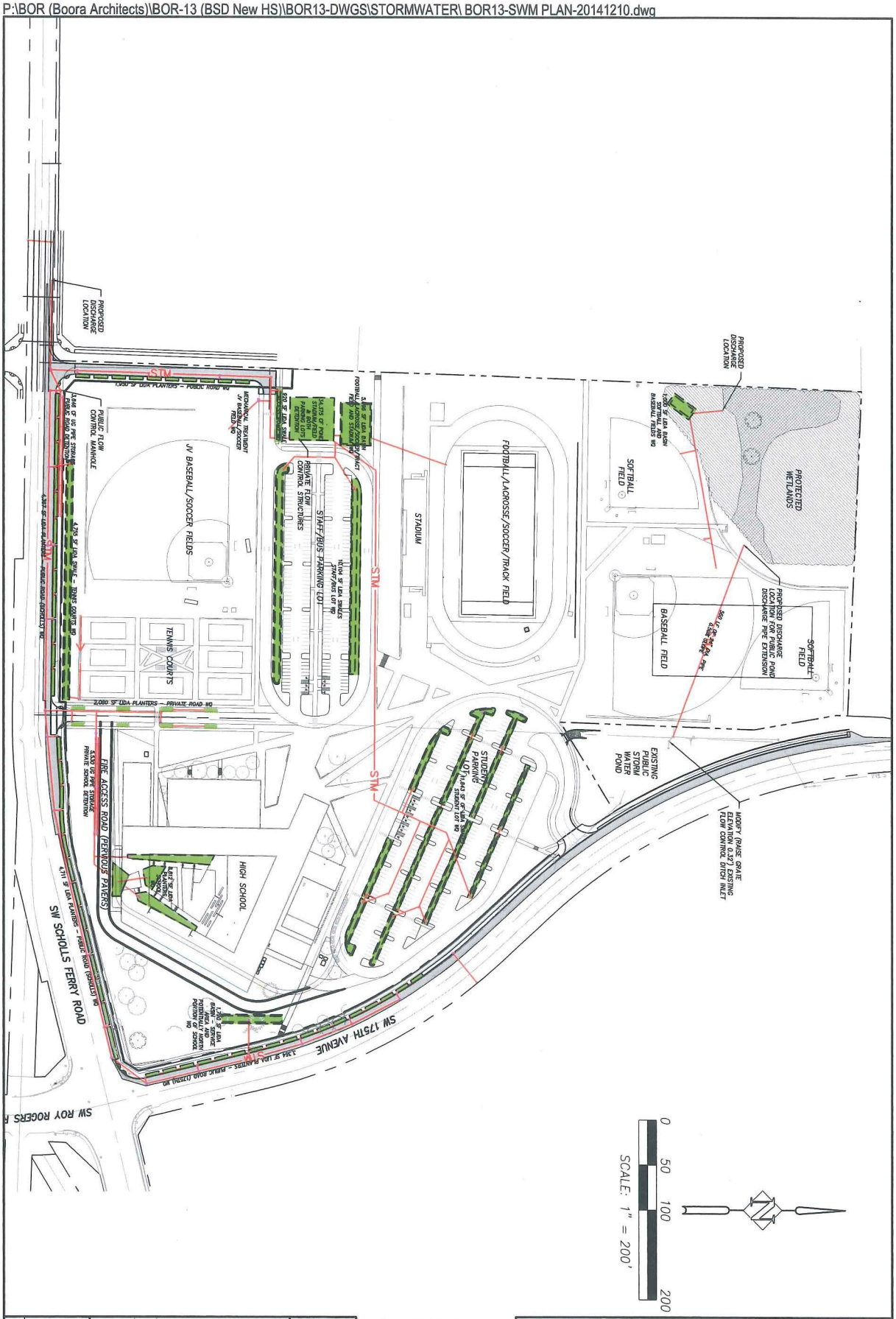
phone: 503.221.1131 www.hhpr.com fax: 503.221.1171

PROPOSED BASINS
SCM HIGH SCHOOL
BEAVERTON, OREGON

P:\BOR (Boora Architects)\BOR-13 (BSD New HS)\BOR13-DWGS\STORMWATER\ BOR13-SWM PLAN-20141210.dwg



JOB NO.	SHEET NO.
BOR-13	3

DATE	NO.	DESCRIPTION
REVISIONS		

DESIGNED:	AMM
DRAWN:	AMM
CHECKED:	HHPR
DATE:	JANUARY 2015

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phone: 503.221.1131 www.hhpr.com fax: 503.221.1171

STORMWATER MANAGEMENT PLAN
SCM HIGH SCHOOL
BEAVERTON, OREGON

SCM High School

Basin Area Breakdown and Characteristic

Prepared by Harper Houf Peterson Righellis Inc.
Job No. BOR-13
January 2015

NRCS Curve Numbers (CN) used:

Ground Cover	C	D	Condition
Small Grain Countoured (Poor Condition)	82	85	Existing fields
Brush (Fair Condition)	70	77	Existing roadside ditches and Wetland
Open Space (Good Condition)	74	80	Proposed landscaped areas
LIDA (equivlant to Woods in Good Condition)	70	77	Proposed LIDA areas
Impervious	98	98	Existing & proposed

Hydrologic Group: C & D (w/in Wetland) Existing Basin N1 and Proposed Basins 13 & 15 contain type D soils

Existing Conditions:

ONSITE:

BASIN	TOTAL AREA (SF)	TOTAL AREA (AC)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (SF)	PERVIOUS AREA (AC)	t_c (min)	Composite Hydrologic Curve Number (CN)
N1	717,762	16.5	0	0.0	717,762	16.5	22.9	82.9
N2	60,269	1.4	0	0.0	60,269	1.4	17.6	82.0
N3	95,118	2.2	0	0.0	95,118	2.2	21.9	82.0
S1	223,280	5.1	0	0.0	223,280	5.1	28.3	82.0
S2	533,298	12.2	8,033	0.18	525,265	12.06	21.7	82.0
S3	457,528	10.5	123	0.0	457,405	10.5	24.8	82.0
TOTAL	**2,087,255**	**47.9**	**8,156**	**0.2**	**2,079,099**	**47.7**		

OFFSITE:

BASIN	TOTAL AREA (SF)	TOTAL AREA (AC)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (SF)	PERVIOUS AREA (AC)	t_c (min)	Composite Hydrologic Curve Number (CN)
OFF1	32,319	0.7	17,873	0.4	14,446	0.3	5.3	70.0
OFF2	115,864	2.7	47,346	1.1	68,518	1.6	5.2	77.2
OFF3	127,203	2.9	23,540	0.5	103,663	2.4	34.9	82.0
OFF4	636,552	14.6	62,336	1.4	574,216	13.2	6.6	81.2
OFF5	65,970	1.5	2,770	0.1	63,200	1.5	5.0	80.0
OFF6	36,593	0.8	0	0.0	36,593	0.8	5.0	73.5
OFF7	27,769	0.6	17,081	0.4	10,688	0.2	7.0	70.0
OFF8	85,457	2.0	56,364	1.3	29,093	0.7	21.8	70.0
TOTAL	**1,127,727**	**25.9**	**227,310**	**5.2**	**900,417**	**20.7**		

Proposed Conditions:

ONSITE:

BASIN	TOTAL AREA (SF)	TOTAL AREA (AC)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (SF)	PERVIOUS AREA (AC)	t_c (min)	Composite Hydrologic Curve Number (CN)
1	44,660	1.0	14,847	0.3	29,813	0.7	5.0	73.8
2	66,450	1.5	0	0.0	66,450	1.5	5.0	74.0
3	111,769	2.6	878	0.0	110,890	2.5	5.0	74.0
4	79,565	1.8	15,235	0.3	64,330	1.5	5.0	73.6
5	254,345	5.8	162,061	3.7	92,284	2.1	5.0	73.6
6	75,403	1.7	64,000	1.5	11,403	0.3	5.0	74.0
7	32,863	0.8	0	0.0	32,863	0.8	5.0	73.4
8	13,285	0.3	8,769	0.2	4,516	0.1	5.0	75.4
9	47,299	1.1	25,813	0.6	21,486	0.5	5.0	76.7
10	174,392	4.0	165,580	3.8	8,812	0.2	5.0	70.0
11	32,344	0.7	3,250	0.1	29,094	0.7	5.0	73.0
12A	112,591	2.6	993	0.0	111,598	2.6	5.0	73.9
12B	25,272	0.6	20,535	0.5	4,737	0.1	5.0	70.0
13	174,151	4.0	1,547	0.0	172,604	4.0	5.0	73.6
14	53,945	1.2	13,221	0.3	40,724	0.9	5.0	70.0
15	250,826	5.8	3,038	0.1	247,788	5.7	5.0	73.5
16	266,810	6.1	79,767	1.8	187,043	4.3	5.0	76.8
17	231,533	5.3	190,633	4.4	40,900	0.9	5.0	72.8
TOTAL	**2,047,502**	**47.0**	**770,167**	**17.7**	**1,277,335**	**29.3**		

OFFSITE:

BASIN	TOTAL AREA (SF)	TOTAL AREA (AC)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (SF)	PERVIOUS AREA (AC)	t_c (min)	Composite Hydrologic Curve Number (CN)
OFF1	32,319	0.7	17,873	0.4	14,446	0.3	5.3	70.0
OFF2	115,864	2.7	47,346	1.1	68,518	1.6	5.2	77.2
OFF3	157,699	3.6	43,100	1.0	114,599	2.6	34.9	82.0
OFF4	654,172	15.0	74,400	1.7	579,772	13.3	6.6	81.2
OFF5	36,094	0.8	0	0.0	36,094	0.8	5.0	80.0
OFF6	27,977	0.6	0	0.0	27,977	0.6	5.0	73.5
OFF7	39,605	0.9	36,029	0.8	3,576	0.1	5.0	70.0
OFF8	103,750	2.4	97,254	2.2	6,496	0.1	5.2	70.0
TOTAL	**1,167,480**	**26.8**	**316,002**	**7.3**	**851,478**	**19.5**		

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin1**	**Basin2**	**Basin3**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Woods	Woods	Woods
Manning's Roughness Coefficient		0.4	0.4	0.4
Flow Length , L (<300 ft)	ft	300	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.091	0.131	0.056
OUTPUT				
Travel Time	hr	0.53	0.46	0.65
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	346	445	85
Watercourse Slope, s	ft/ft	0.035	0.038	0.153
OUTPUT				
Average Velocity, V	ft/s	3.02	3.15	6.31
Travel Time	hr	0.03	0.04	0.004
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	8	8	16
Wetted Perimeter, p_w	ft	7.7	7.7	10.9
Channel Slope, s	ft/ft	0.032	0.016	0.021
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	88	137	14
OUTPUT				
Average Velocity, V	ft/s	9.09	6.38	9.39
Hydraulic Radius, $r = a/p_w$	ft	1.04	1.04	1.47
Travel Time	hr	0.00	0.01	0.00
Basin Time of Concentration, T_c	**hrs**	**0.57**	**0.50**	**0.65**
	min	**33.9**	**30.3**	**39.0**

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin4**	**Basin5**	**Basin6**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Cultivated	Woods	Cultivated
Manning's Roughness Coefficient		0.06	0.4	0.06
Flow Length , L (<300 ft)	ft	44	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.114	0.115	0.037
OUTPUT				
Travel Time	hr	0.02	0.48	0.17
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	814	304	734
Watercourse Slope, s	ft/ft	0.035	0.108	0.041
OUTPUT				
Average Velocity, V	ft/s	3.02	5.29	3.26
Travel Time	hr	0.07	0.02	0.06
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	8	8	154
Wetted Perimeter, p_w	ft	8.9	8.9	34.6
Channel Slope, s	ft/ft	0.034	0.016	0.015
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	168	63	206
OUTPUT				
Average Velocity, V	ft/s	8.52	5.83	16.49
Hydraulic Radius, $r = a/p_w$	ft	0.90	0.90	4.45
Travel Time	hr	0.01	0.00	0.00
Basin Time of Concentration, T_c	**hrs**	**0.10**	**0.50**	**0.23**
	min	**6.2**	**30.2**	**14.0**

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin7**	**Basin8**	**Basin9**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Dense Grass	Cultivated	Cultivated
Manning's Roughness Coefficient		0.24	0.06	0.06
Flow Length , L (<300 ft)	ft	29	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.172	0.028	0.041
OUTPUT				
Travel Time	hr	0.04	0.19	0.16
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Paved	Unpaved
Flow Length, L	ft	489	333	190
Watercourse Slope, s	ft/ft	0.058	0.038	0.066
OUTPUT				
Average Velocity, V	ft/s	3.90	3.99	4.14
Travel Time	hr	0.03	0.02	0.01
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	0.0	20	0.0
Wetted Perimeter, p_w	ft	0	12.8	0
Channel Slope, s	ft/ft	0.000	0.016	0.000
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	0	63	0
OUTPUT				
Average Velocity, V	ft/s	0.00	8.43	0.00
Hydraulic Radius, $r = a/p_w$	ft	1.00	1.56	1.00
Travel Time	hr	0.00	0.00	0.00
Basin Time of Concentration, T_c	**hrs**	**0.08**	**0.21**	**0.17**
	min	**4.6**	**12.7**	**10.4**

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin10**	**Basin23**	**Basin50**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Dense Grass	Cultivated	Woods
Manning's Roughness Coefficient		0.24	0.06	0.4
Flow Length , L (<300 ft)	ft	92	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.070	0.023	0.087
OUTPUT				
Travel Time	hr	0.15	0.20	0.54
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	0	922	450
Watercourse Slope, s	ft/ft	0.000	0.028	0.169
OUTPUT				
Average Velocity, V	ft/s	0.00	2.71	6.63
Travel Time	hr	0.00	0.09	0.02
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	0.0	0.0	8.0
Wetted Perimeter, p_w	ft	0	0.0	7.7
Channel Slope, s	ft/ft	0.000	0.000	0.068
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	0	0	4823
OUTPUT				
Average Velocity, V	ft/s	0.00	0.00	13.29
Hydraulic Radius, $r = a/p_w$	ft	1.00	1.00	1.04
Travel Time	hr	0.00	0.00	0.10
Basin Time of Concentration, T_c	**hrs**	**0.15**	**0.30**	**0.66**
	min	**9.2**	**17.7**	**39.7**

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin51**	**Basin52**	**Basin53**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Cultivated	Cultivated	Cultivated
Manning's Roughness Coefficient		0.06	0.06	0.06
Flow Length , L (<300 ft)	ft	300	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.075	0.056	0.046
OUTPUT				
Travel Time	hr	0.13	0.14	0.15
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	430	166	271
Watercourse Slope, s	ft/ft	0.082	0.090	0.074
OUTPUT				
Average Velocity, V	ft/s	4.63	4.85	4.38
Travel Time	hr	0.03	0.01	0.02
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	0.0	0.0	2.5
Wetted Perimeter, p_w	ft	0	0	5
Channel Slope, s	ft/ft	0.000	0.000	0.038
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	0	453	223
OUTPUT				
Average Velocity, V	ft/s	0.00	0.00	6.28
Hydraulic Radius, $r = a/p_w$	ft	1.00	1.00	0.52
Travel Time	hr	0.00	0.00	0.01
Basin Time of Concentration, T_c	**hrs**	**0.15**	**0.15**	**0.18**
	min	**9.1**	**9.1**	**10.8**

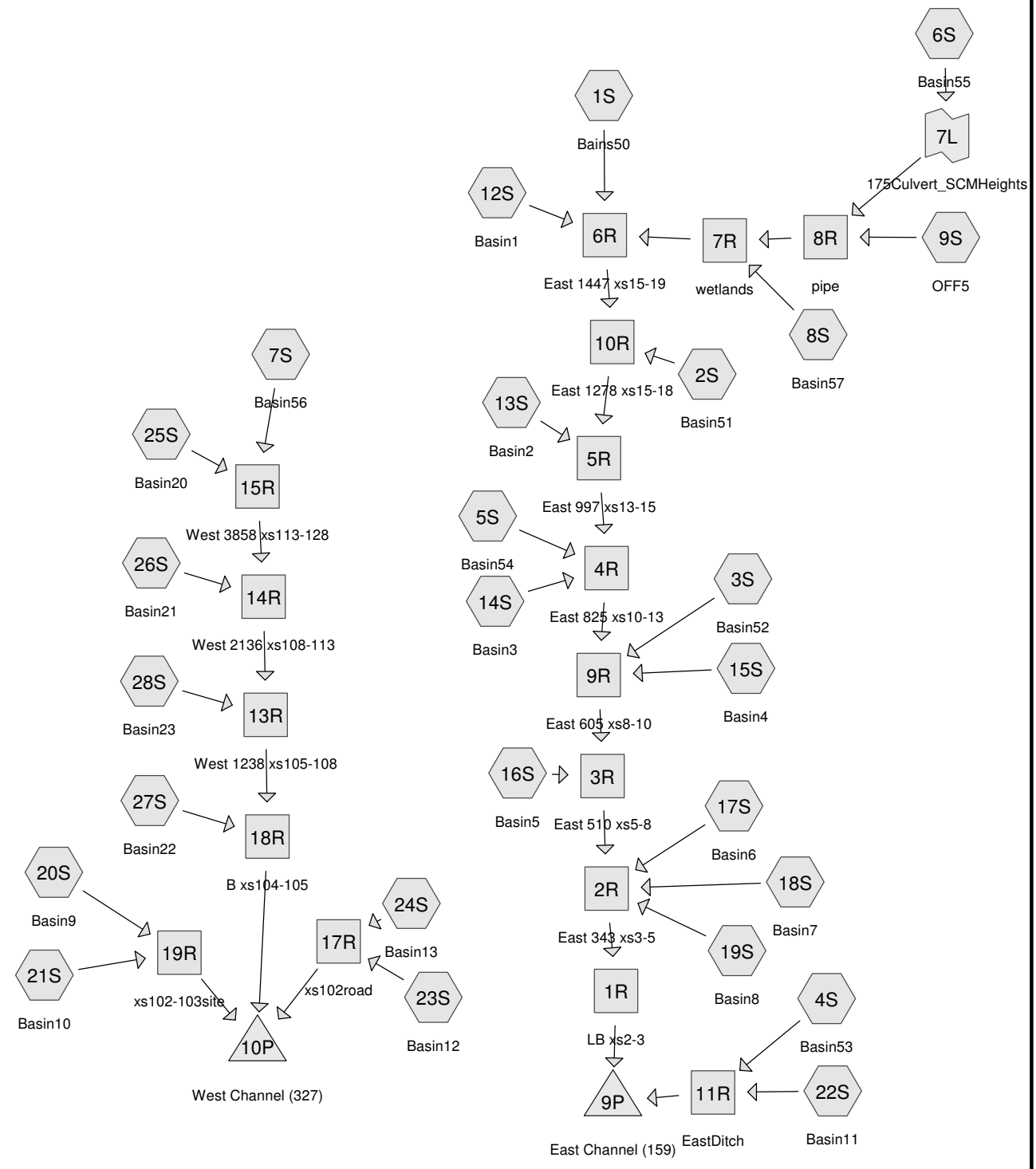
Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin54**	**Basin55**	**Basin56**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Dense Grass	Woods	Woods
Manning's Roughness Coefficient		0.24	0.4	0.4
Flow Length , L (<300 ft)	ft	300	300	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.090	0.107	0.10
OUTPUT				
Travel Time	hr	0.36	0.50	0.52
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	283	650	4752
Watercourse Slope, s	ft/ft	0.223	0.134	0.067
OUTPUT				
Average Velocity, V	ft/s	7.61	5.90	4.19
Travel Time	hr	0.01	0.03	0.32
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	0.0	2.5	2.5
Wetted Perimeter, p_w	ft	0	5	5
Channel Slope, s	ft/ft	0.000	0.092	0.038
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	0	2194	223
OUTPUT				
Average Velocity, V	ft/s	0.00	9.73	6.28
Hydraulic Radius, $r = a/p_w$	ft	1.00	0.52	0.52
Travel Time	hr	0.00	0.00	0.01
Basin Time of Concentration, T_c	**hrs**	**0.37**	**0.53**	**0.84**
	min	**21.9**	**31.8**	**50.7**

Time of Concentration Calculations

Project Name: Lolich Bellairs Flood Study			By: RCH	Date: 10/25/16
Project Number: 17849			Check:	Date:
BASINS		**Basin 20**	**Basin 21**	**Basin 22**
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Cultivated	Cultivated	Cultivated
Manning's Roughness Coefficient		0.06	0.06	0.06
Flow Length , L (<300 ft)	ft	300	287	300
2-Year, 24-Hour Rainfall, P_2	in	2.5	2.5	2.5
Land Slope, s	ft/ft	0.043	0.021	0.10
OUTPUT				
Travel Time	hr	0.16	0.20	0.11
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved	Unpaved	Unpaved
Flow Length, L	ft	1748	1400	1332
Watercourse Slope, s	ft/ft	0.057	0.022	0.068
OUTPUT				
Average Velocity, V	ft/s	3.84	2.40	4.22
Travel Time	hr	0.13	0.16	0.09
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	8.0	0.0	8.0
Wetted Perimeter, p_w	ft	7.7	0	7.7
Channel Slope, s	ft/ft	0.020	0.000	0.087
Manning's Roughness Coefficient		0.03	0.03	0.03
Flow Length, L	ft	870	0	138
OUTPUT				
Average Velocity, V	ft/s	7.12	0.00	15.02
Hydraulic Radius, $r = a/p_w$	ft	1.04	1.00	1.04
Travel Time	hr	0.03	0.00	0.00
Basin Time of Concentration, T_c	**hrs**	**0.32**	**0.36**	**0.20**
	min	**19.0**	**21.9**	**12.2**

Appendix B—HydroCAD and HY8 Results



Routing Diagram for 17849_Hydrology
Prepared by Otak, Inc., Printed 11/29/2016

Summary for Subcatchment 1S: Bains50

Runoff = 42.46 cfs @ 8.15 hrs, Volume= 26.947 af, Depth= 2.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
305,218	98	Unconnected pavement, HSG C
5,799,140	72	Woods/grass comb., Good, HSG C
44,457	98	Unconnected pavement, HSG D
844,681	79	Woods/grass comb., Good, HSG D
6,993,496	74	Weighted Average
6,643,821		95.00% Pervious Area
349,675		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.7					**Direct Entry,**

Summary for Subcatchment 2S: Basin51

Runoff = 1.83 cfs @ 8.00 hrs, Volume= 0.740 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
9,797	98	Unconnected pavement, HSG C
186,137	72	Woods/grass comb., Good, HSG C
155	98	Unconnected pavement, HSG D
2,938	79	Woods/grass comb., Good, HSG D
199,027	73	Weighted Average
189,075		95.00% Pervious Area
9,952		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1					**Direct Entry,**

Summary for Subcatchment 3S: Basin52

Runoff = 0.56 cfs @ 8.00 hrs, Volume= 0.228 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
3,064	98	Unconnected pavement, HSG C
58,221	72	Woods/grass comb., Good, HSG C
61,285	73	Weighted Average
58,221		95.00% Pervious Area
3,064		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1					**Direct Entry,**

Summary for Subcatchment 4S: Basin53

Runoff = 1.69 cfs @ 8.00 hrs, Volume= 0.628 af, Depth= 2.57"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
12,799	98	Unconnected pavement, HSG C
115,187	79	Woods/grass comb., Good, HSG D
127,986	81	Weighted Average
115,187		90.00% Pervious Area
12,799		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8					**Direct Entry,**

Summary for Subcatchment 5S: Basin54

Runoff = 1.47 cfs @ 8.01 hrs, Volume= 0.725 af, Depth= 2.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
18,330	98	Unconnected pavement, HSG C
164,966	72	Woods/grass comb., Good, HSG C
145	79	Woods/grass comb., Good, HSG D
183,441	75	Weighted Average
165,111		90.01% Pervious Area
18,330		9.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9					**Direct Entry,**

Summary for Subcatchment 6S: Basin55

Runoff = 8.76 cfs @ 8.07 hrs, Volume= 5.038 af, Depth= 2.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
127,555	98	Unconnected pavement, HSG C
1,147,997	72	Woods/grass comb., Good, HSG C
1,275,552	75	Weighted Average
1,147,997		90.00% Pervious Area
127,555		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.8					**Direct Entry,**

Summary for Subcatchment 7S: Basin56

Runoff = 25.82 cfs @ 8.23 hrs, Volume= 18.183 af, Depth= 2.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
437,086	98	Unconnected pavement, HSG C
3,933,773	72	Woods/grass comb., Good, HSG C
23,259	98	Unconnected pavement, HSG D
209,329	79	Woods/grass comb., Good, HSG D
4,603,447	75	Weighted Average
4,143,102		90.00% Pervious Area
460,345		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.7					**Direct Entry,**

Summary for Subcatchment 8S: Basin57

Runoff = 3.96 cfs @ 7.96 hrs, Volume= 1.398 af, Depth= 2.40"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
13,221	98	Unconnected pavement, HSG C
40,724	72	Woods/grass comb., Good, HSG C
3,038	98	Unconnected pavement, HSG D
247,788	79	Woods/grass comb., Good, HSG D
304,771	79	Weighted Average
288,512		94.67% Pervious Area
16,259		5.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 9S: OFF5

Runoff = 0.47 cfs @ 7.96 hrs, Volume= 0.164 af, Depth= 2.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
36,094	79	Woods/grass comb., Good, HSG D
36,094		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 12S: Basin1

Runoff = 1.83 cfs @ 8.05 hrs, Volume= 0.974 af, Depth= 2.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
3,290	98	Unconnected pavement, HSG C
29,607	72	Woods/grass comb., Good, HSG C
17,167	98	Unconnected pavement, HSG D
154,504	79	Woods/grass comb., Good, HSG D
204,568	80	Weighted Average
184,111		90.00% Pervious Area
20,457		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.9					**Direct Entry,**

Summary for Subcatchment 13S: Basin2

Runoff = 0.81 cfs @ 8.03 hrs, Volume= 0.425 af, Depth= 2.31"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
1,478	98	Unconnected pavement, HSG C
28,075	72	Woods/grass comb., Good, HSG C
3,321	98	Unconnected pavement, HSG D
63,092	79	Woods/grass comb., Good, HSG D
95,966	78	Weighted Average
91,167		95.00% Pervious Area
4,799		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3					**Direct Entry,**

Summary for Subcatchment 14S: Basin3

Runoff = 0.34 cfs @ 8.13 hrs, Volume= 0.203 af, Depth= 2.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
1,477	98	Unconnected pavement, HSG C
28,066	72	Woods/grass comb., Good, HSG C
983	98	Unconnected pavement, HSG D
18,686	79	Woods/grass comb., Good, HSG D
49,212	76	Weighted Average
46,752		95.00% Pervious Area
2,460		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0					**Direct Entry,**

Summary for Subcatchment 15S: Basin4

Runoff = 0.77 cfs @ 8.00 hrs, Volume= 0.299 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
3,932	98	Unconnected pavement, HSG C
74,709	72	Woods/grass comb., Good, HSG C
94	98	Unconnected pavement, HSG D
1,777	79	Woods/grass comb., Good, HSG D
80,512	73	Weighted Average
76,486		95.00% Pervious Area
4,026		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2					**Direct Entry,**

Summary for Subcatchment 16S: Basin5

Runoff = 3.21 cfs @ 8.02 hrs, Volume= 1.658 af, Depth= 2.42"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
8,278	98	Unconnected pavement, HSG C
74,500	72	Woods/grass comb., Good, HSG C
27,595	98	Unconnected pavement, HSG D
248,359	79	Woods/grass comb., Good, HSG D
358,732	79	Weighted Average
322,859		90.00% Pervious Area
35,873		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.2					**Direct Entry,**

Summary for Subcatchment 17S: Basin6

Runoff = 2.42 cfs @ 8.00 hrs, Volume= 0.953 af, Depth= 2.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
3,583	98	Unconnected pavement, HSG C
32,243	72	Woods/grass comb., Good, HSG C
16,430	98	Unconnected pavement, HSG D
147,872	79	Woods/grass comb., Good, HSG D
200,128	80	Weighted Average
180,115		90.00% Pervious Area
20,013		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0					**Direct Entry,**

Summary for Subcatchment 18S: Basin7

Runoff = 1.33 cfs @ 7.97 hrs, Volume= 0.497 af, Depth= 2.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
18,808	98	Unconnected pavement, HSG C
98,741	72	Woods/grass comb., Good, HSG C
117,549	76	Weighted Average
98,741		84.00% Pervious Area
18,808		16.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 19S: Basin8

Runoff = 0.56 cfs @ 8.00 hrs, Volume= 0.228 af, Depth= 2.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
1,710	98	Unconnected pavement, HSG C
32,490	72	Woods/grass comb., Good, HSG C
1,042	98	Unconnected pavement, HSG D
19,804	79	Woods/grass comb., Good, HSG D
55,046	76	Weighted Average
52,294		95.00% Pervious Area
2,752		5.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7					**Direct Entry,**

Summary for Subcatchment 20S: Basin9

Runoff = 0.52 cfs @ 8.00 hrs, Volume= 0.212 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
986	98	Unconnected pavement, HSG C
48,317	72	Woods/grass comb., Good, HSG C
155	98	Unconnected pavement, HSG D
7,597	79	Woods/grass comb., Good, HSG D
57,055	73	Weighted Average
55,914		98.00% Pervious Area
1,141		2.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4					**Direct Entry,**

Summary for Subcatchment 21S: Basin10

Runoff = 0.04 cfs @ 8.00 hrs, Volume= 0.015 af, Depth= 1.82"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
4,220	72	Woods/grass comb., Good, HSG C
4,220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2					**Direct Entry,**

Summary for Subcatchment 22S: Basin11

Runoff = 0.35 cfs @ 7.89 hrs, Volume= 0.121 af, Depth= 3.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
12,973	98	Unconnected pavement, HSG C
4,324	72	Woods/grass comb., Good, HSG C
17,297	92	Weighted Average
4,324		25.00% Pervious Area
12,973		75.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 23S: Basin12

Runoff = 0.09 cfs @ 7.91 hrs, Volume= 0.030 af, Depth= 3.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
2,830	98	Unconnected pavement, HSG C
1,887	72	Woods/grass comb., Good, HSG C
4,717	88	Weighted Average
1,887		40.00% Pervious Area
2,830		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 24S: Basin13

Runoff = 0.08 cfs @ 7.91 hrs, Volume= 0.029 af, Depth= 3.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
2,795	98	Unconnected pavement, HSG C
1,864	72	Woods/grass comb., Good, HSG C
4,659	88	Weighted Average
1,864		40.01% Pervious Area
2,795		59.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 25S: Basin20

Runoff = 25.27 cfs @ 8.01 hrs, Volume= 12.051 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
56,843	98	Unconnected pavement, HSG C
2,785,286	72	Woods/grass comb., Good, HSG C
7,999	98	Unconnected pavement, HSG D
391,973	79	Woods/grass comb., Good, HSG D
3,242,101	73	Weighted Average
3,177,259		98.00% Pervious Area
64,842		2.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0					**Direct Entry,**

Summary for Subcatchment 26S: Basin21

Runoff = 11.70 cfs @ 8.01 hrs, Volume= 5.674 af, Depth= 2.13"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
116,978	98	Unconnected pavement, HSG C
1,052,800	72	Woods/grass comb., Good, HSG C
22,114	98	Unconnected pavement, HSG D
199,025	79	Woods/grass comb., Good, HSG D
1,390,917	76	Weighted Average
1,251,825		90.00% Pervious Area
139,092		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9					**Direct Entry,**

Summary for Subcatchment 27S: Basin22

Runoff = 6.05 cfs @ 8.00 hrs, Volume= 2.456 af, Depth= 2.09"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
6,282	98	Unconnected pavement, HSG C
307,800	72	Woods/grass comb., Good, HSG C
5,974	98	Unconnected pavement, HSG D
292,714	79	Woods/grass comb., Good, HSG D
612,770	76	Weighted Average
600,514		98.00% Pervious Area
12,256		2.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2					**Direct Entry,**

Summary for Subcatchment 28S: Basin23

Runoff = 7.69 cfs @ 8.01 hrs, Volume= 3.417 af, Depth= 2.20"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (sf)	CN	Description
56,850	98	Unconnected pavement, HSG C
511,646	72	Woods/grass comb., Good, HSG C
24,280	98	Unconnected pavement, HSG D
218,521	79	Woods/grass comb., Good, HSG D
811,297	76	Weighted Average
730,167		90.00% Pervious Area
81,130		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry,**

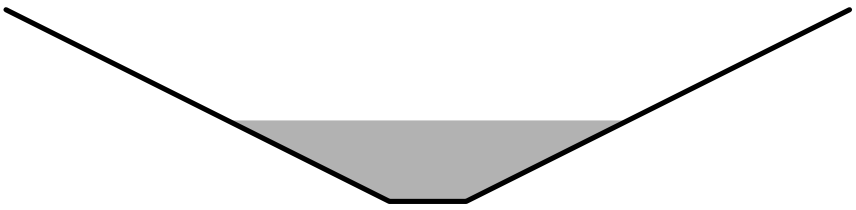
Summary for Reach 1R: LB xs2-3

Inflow Area = 234.513 ac, 6.21% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 75.69 cfs @ 8.08 hrs, Volume= 44.605 af
Outflow = 75.69 cfs @ 8.09 hrs, Volume= 44.605 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.76 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.78 fps, Avg. Travel Time= 0.6 min

Peak Storage= 1,314 cf @ 8.09 hrs
Average Depth at Peak Storage= 2.11'
Bank-Full Depth= 5.00' Flow Area= 60.0 sf, Capacity= 574.91 cfs

2.00' x 5.00' deep channel, n= 0.040
Side Slope Z-value= 2.0 '/' Top Width= 22.00'
Length= 100.0' Slope= 0.0200 '/'
Inlet Invert= 242.00', Outlet Invert= 240.00'



Summary for Reach 2R: East 343 xs3-5

Inflow Area = 234.513 ac, 6.21% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 75.70 cfs @ 8.08 hrs, Volume= 44.605 af
Outflow = 75.69 cfs @ 8.08 hrs, Volume= 44.605 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.85 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.23 fps, Avg. Travel Time= 1.3 min

Peak Storage= 2,807 cf @ 8.08 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 7.00' Flow Area= 238.0 sf, Capacity= 4,189.86 cfs

20.00' x 7.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 48.00'
Length= 180.0' Slope= 0.0222 '/'
Inlet Invert= 246.00', Outlet Invert= 242.00'

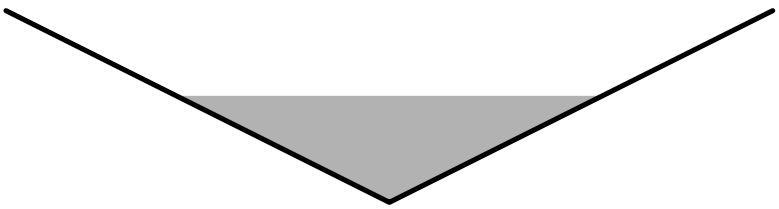
Summary for Reach 3R: East 510 xs5-8

Inflow Area = 225.956 ac, 6.02% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 71.92 cfs @ 8.10 hrs, Volume= 42.926 af
Outflow = 71.92 cfs @ 8.11 hrs, Volume= 42.926 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.26 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.47 fps, Avg. Travel Time= 0.8 min

Peak Storage= 1,684 cf @ 8.11 hrs
Average Depth at Peak Storage= 2.23'
Bank-Full Depth= 4.00' Flow Area= 32.0 sf, Capacity= 343.36 cfs

0.00' x 4.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 170.0' Slope= 0.0294 '/'
Inlet Invert= 251.00', Outlet Invert= 246.00'



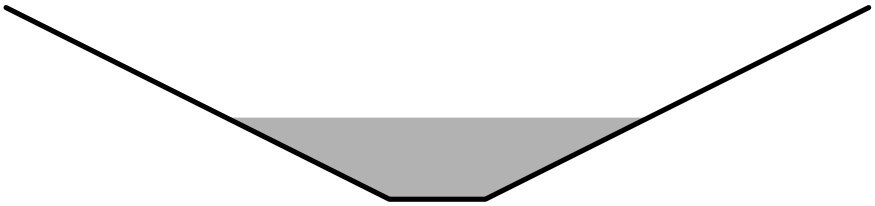
Summary for Reach 4R: East 825 xs10-13

Inflow Area = 214.466 ac, 5.88% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 67.64 cfs @ 8.11 hrs, Volume= 40.741 af
Outflow = 67.64 cfs @ 8.12 hrs, Volume= 40.741 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.35 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.60 fps, Avg. Travel Time= 1.0 min

Peak Storage= 2,023 cf @ 8.12 hrs
Average Depth at Peak Storage= 1.70'
Bank-Full Depth= 4.00' Flow Area= 40.0 sf, Capacity= 482.67 cfs

2.00' x 4.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 18.00'
Length= 220.0' Slope= 0.0318 '/'
Inlet Invert= 260.00', Outlet Invert= 253.00'



Summary for Reach 5R: East 997 xs13-15

Inflow Area = 209.125 ac, 5.80% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 65.89 cfs @ 8.11 hrs, Volume= 39.813 af
Outflow = 65.89 cfs @ 8.11 hrs, Volume= 39.813 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.28 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.34 fps, Avg. Travel Time= 0.8 min

Peak Storage= 1,539 cf @ 8.11 hrs
Average Depth at Peak Storage= 1.51'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 118.85 cfs

3.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 170.0' Slope= 0.0324 '/'
Inlet Invert= 265.50', Outlet Invert= 260.00'

Summary for Reach 6R: East 1447 xs15-19

Inflow Area = 202.353 ac, 5.83% Impervious, Inflow Depth = 2.29" for 100-year Storm event
Inflow = 63.53 cfs @ 8.11 hrs, Volume= 38.649 af
Outflow = 63.52 cfs @ 8.12 hrs, Volume= 38.649 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.81 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.71 fps, Avg. Travel Time= 1.0 min

Peak Storage= 1,859 cf @ 8.12 hrs
Average Depth at Peak Storage= 1.89'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 71.97 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 170.0' Slope= 0.0176 '/'
Inlet Invert= 276.00', Outlet Invert= 273.00'

Summary for Reach 7R: wetlands

Inflow Area = 37.108 ac, 8.90% Impervious, Inflow Depth = 3.47" for 100-year Storm event
Inflow = 20.92 cfs @ 7.78 hrs, Volume= 10.728 af
Outflow = 19.43 cfs @ 8.05 hrs, Volume= 10.728 af, Atten= 7%, Lag= 16.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.07 fps, Min. Travel Time= 9.7 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 21.4 min

Peak Storage= 11,272 cf @ 8.05 hrs
Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 39.66 cfs

2.00' x 2.00' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 1,200.0' Slope= 0.0158 '/'
Inlet Invert= 297.00', Outlet Invert= 278.00'

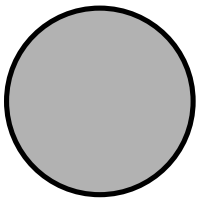
Summary for Reach 8R: pipe

Inflow Area = 30.111 ac, 9.72% Impervious, Inflow Depth = 3.72" for 100-year Storm event
Inflow = 21.10 cfs @ 8.00 hrs, Volume= 9.330 af
Outflow = 17.23 cfs @ 8.73 hrs, Volume= 9.330 af, Atten= 18%, Lag= 44.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.80 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 3.53 fps, Avg. Travel Time= 2.6 min

Peak Storage= 1,759 cf @ 7.79 hrs
Average Depth at Peak Storage= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 16.00 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 560.0' Slope= 0.0050 '/'
Inlet Invert= 316.00', Outlet Invert= 313.20'



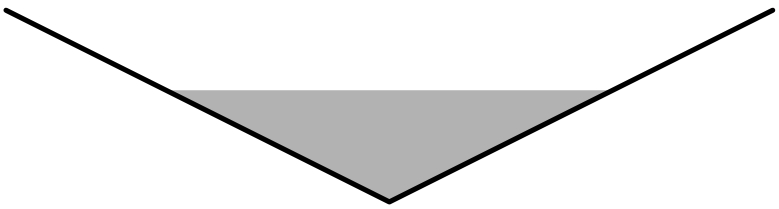
Summary for Reach 9R: East 605 xs8-10

Inflow Area = 217.721 ac, 5.87% Impervious, Inflow Depth = 2.27" for 100-year Storm event
Inflow = 68.73 cfs @ 8.10 hrs, Volume= 41.268 af
Outflow = 68.73 cfs @ 8.11 hrs, Volume= 41.268 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.33 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.02 fps, Avg. Travel Time= 0.5 min

Peak Storage= 1,031 cf @ 8.11 hrs
Average Depth at Peak Storage= 2.33'
Bank-Full Depth= 4.00' Flow Area= 32.0 sf, Capacity= 290.49 cfs

0.00' x 4.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 95.0' Slope= 0.0211 '/'
Inlet Invert= 253.00', Outlet Invert= 251.00'



Summary for Reach 10R: East 1278 xs15-18

Inflow Area = 206.922 ac, 5.81% Impervious, Inflow Depth = 2.28" for 100-year Storm event
Inflow = 65.09 cfs @ 8.10 hrs, Volume= 39.389 af
Outflow = 65.08 cfs @ 8.11 hrs, Volume= 39.389 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.83 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 3.20 fps, Avg. Travel Time= 1.5 min

Peak Storage= 2,668 cf @ 8.11 hrs
Average Depth at Peak Storage= 1.74'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 88.66 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 280.0' Slope= 0.0268 '/'
Inlet Invert= 273.00', Outlet Invert= 265.50'

Summary for Reach 11R: EastDitch

Inflow Area = 3.335 ac, 17.74% Impervious, Inflow Depth = 2.69" for 100-year Storm event
Inflow = 2.04 cfs @ 8.00 hrs, Volume= 0.749 af
Outflow = 2.03 cfs @ 8.00 hrs, Volume= 0.749 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.57 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 1.3 min

Peak Storage= 78 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 116.49 cfs

6.00' x 2.00' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 60.0' Slope= 0.0667 '/'
Inlet Invert= 251.30', Outlet Invert= 247.30'

Summary for Reach 13R: West 1238 xs105-108

Inflow Area = 230.665 ac, 7.42% Impervious, Inflow Depth = 2.05" for 100-year Storm event
Inflow = 67.48 cfs @ 8.14 hrs, Volume= 39.326 af
Outflow = 67.31 cfs @ 8.17 hrs, Volume= 39.326 af, Atten= 0%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.07 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 2.85 fps, Avg. Travel Time= 5.2 min

Peak Storage= 9,864 cf @ 8.17 hrs
Average Depth at Peak Storage= 1.91'
Bank-Full Depth= 2.20' Flow Area= 14.1 sf, Capacity= 92.74 cfs

2.00' x 2.20' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 10.80'
Length= 890.0' Slope= 0.0191 '/'
Inlet Invert= 265.00', Outlet Invert= 248.00'

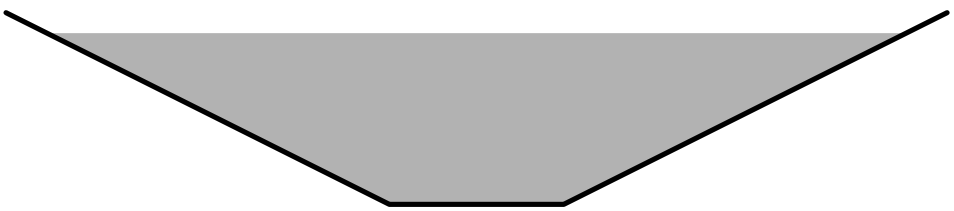
Summary for Reach 14R: West 2136 xs108-113

Inflow Area = 212.040 ac, 7.19% Impervious, Inflow Depth = 2.03" for 100-year Storm event
Inflow = 60.65 cfs @ 8.11 hrs, Volume= 35.909 af
Outflow = 60.44 cfs @ 8.16 hrs, Volume= 35.909 af, Atten= 0%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.19 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 2.48 fps, Avg. Travel Time= 6.0 min

Peak Storage= 10,366 cf @ 8.16 hrs
Average Depth at Peak Storage= 1.96'
Bank-Full Depth= 2.20' Flow Area= 14.1 sf, Capacity= 77.92 cfs

2.00' x 2.20' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 10.80'
Length= 890.0' Slope= 0.0135 '/'
Inlet Invert= 277.00', Outlet Invert= 265.00'



Summary for Reach 15R: West 3858 xs113-128

Inflow Area = 180.109 ac, 6.69% Impervious, Inflow Depth = 2.01" for 100-year Storm event
Inflow = 50.03 cfs @ 8.03 hrs, Volume= 30.235 af
Outflow = 49.43 cfs @ 8.14 hrs, Volume= 30.235 af, Atten= 1%, Lag= 6.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.68 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 3.29 fps, Avg. Travel Time= 9.6 min

Peak Storage= 14,054 cf @ 8.14 hrs
Average Depth at Peak Storage= 1.49'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 94.65 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 1,900.0' Slope= 0.0305 '/'
Inlet Invert= 335.00', Outlet Invert= 277.00'

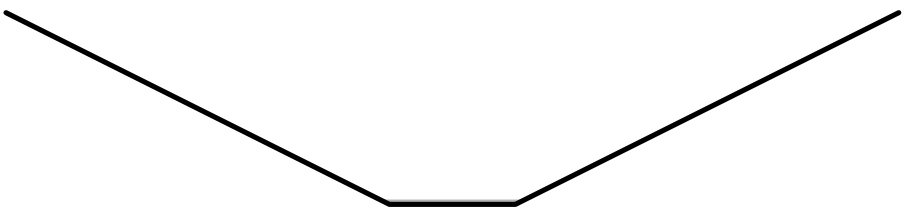
Summary for Reach 17R: xs102road

Inflow Area = 0.215 ac, 59.99% Impervious, Inflow Depth = 3.29" for 100-year Storm event
Inflow = 0.17 cfs @ 7.91 hrs, Volume= 0.059 af
Outflow = 0.17 cfs @ 7.95 hrs, Volume= 0.059 af, Atten= 0%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.65 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 6.7 min

Peak Storage= 39 cf @ 7.95 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 3.80' Flow Area= 38.4 sf, Capacity= 193.97 cfs

2.50' x 3.80' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 17.70'
Length= 150.0' Slope= 0.0300 '/'
Inlet Invert= 246.50', Outlet Invert= 242.00'



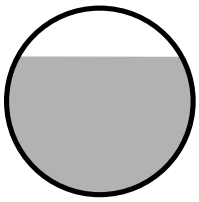
Summary for Reach 18R: B xs104-105

Inflow Area = 244.732 ac, 7.11% Impervious, Inflow Depth = 2.05" for 100-year Storm event
Inflow = 72.39 cfs @ 8.16 hrs, Volume= 41.782 af
Outflow = 72.39 cfs @ 8.16 hrs, Volume= 41.782 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.26 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.49 fps, Avg. Travel Time= 0.2 min

Peak Storage= 349 cf @ 8.16 hrs
Average Depth at Peak Storage= 2.96'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 80.66 cfs

48.0" Round Pipe
n= 0.035 Earth, dense weeds
Length= 35.0' Slope= 0.0229 '/'
Inlet Invert= 247.10', Outlet Invert= 246.30'



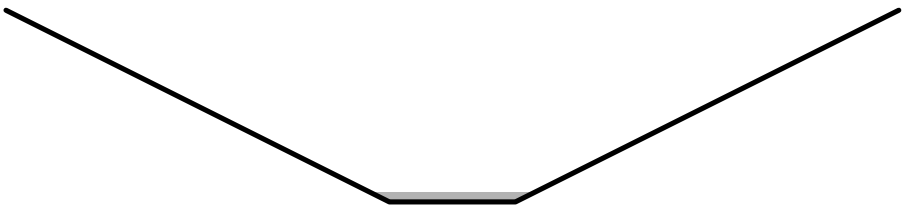
Summary for Reach 19R: xs102-103site

Inflow Area = 1.407 ac, 1.86% Impervious, Inflow Depth = 1.93" for 100-year Storm event
Inflow = 0.56 cfs @ 8.00 hrs, Volume= 0.227 af
Outflow = 0.55 cfs @ 8.01 hrs, Volume= 0.227 af, Atten= 1%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.98 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 4.6 min

Peak Storage= 84 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 3.80' Flow Area= 38.4 sf, Capacity= 193.97 cfs

2.50' x 3.80' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 17.70'
Length= 150.0' Slope= 0.0300 '/'
Inlet Invert= 246.50', Outlet Invert= 242.00'



Summary for Pond 9P: East Channel (159)

Inflow Area = 237.848 ac, 6.37% Impervious, Inflow Depth = 2.29" for 100-year Storm event
Inflow = 77.50 cfs @ 8.08 hrs, Volume= 45.354 af
Primary = 77.50 cfs @ 8.08 hrs, Volume= 45.354 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 10P: West Channel (327)

Inflow Area = 246.354 ac, 7.12% Impervious, Inflow Depth = 2.05" for 100-year Storm event
Inflow = 72.98 cfs @ 8.15 hrs, Volume= 42.068 af
Primary = 72.98 cfs @ 8.15 hrs, Volume= 42.068 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 7L: 175Culvert_SCMHeights

Inflow Area = 29.283 ac, 10.00% Impervious, Inflow Depth = 3.76" for 100-year Storm event
Inflow = 20.63 cfs @ 8.00 hrs, Volume= 9.166 af
Primary = 20.63 cfs @ 8.00 hrs, Volume= 9.166 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Primary Imported from 17974 Pond 281P Hydrograph Table.csv

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: East

Headwater Elevation (ft)	Total Discharge (cfs)	East Discharge (cfs)	Roadway Discharge (cfs)	Iterations
240.30	0.00	0.00	0.00	1
241.64	10.00	10.00	0.00	1
242.30	20.00	20.00	0.00	1
242.84	30.00	30.00	0.00	1
243.35	40.00	40.00	0.00	1
243.92	50.00	50.00	0.00	1
244.60	60.00	60.00	0.00	1
245.43	70.00	70.00	0.00	1
246.14	77.50	77.50	0.00	1
247.49	90.00	90.00	0.00	1
248.71	100.00	100.00	0.00	1
249.16	103.47	103.47	0.00	Overtopping

HY-8 Culvert Analysis Report

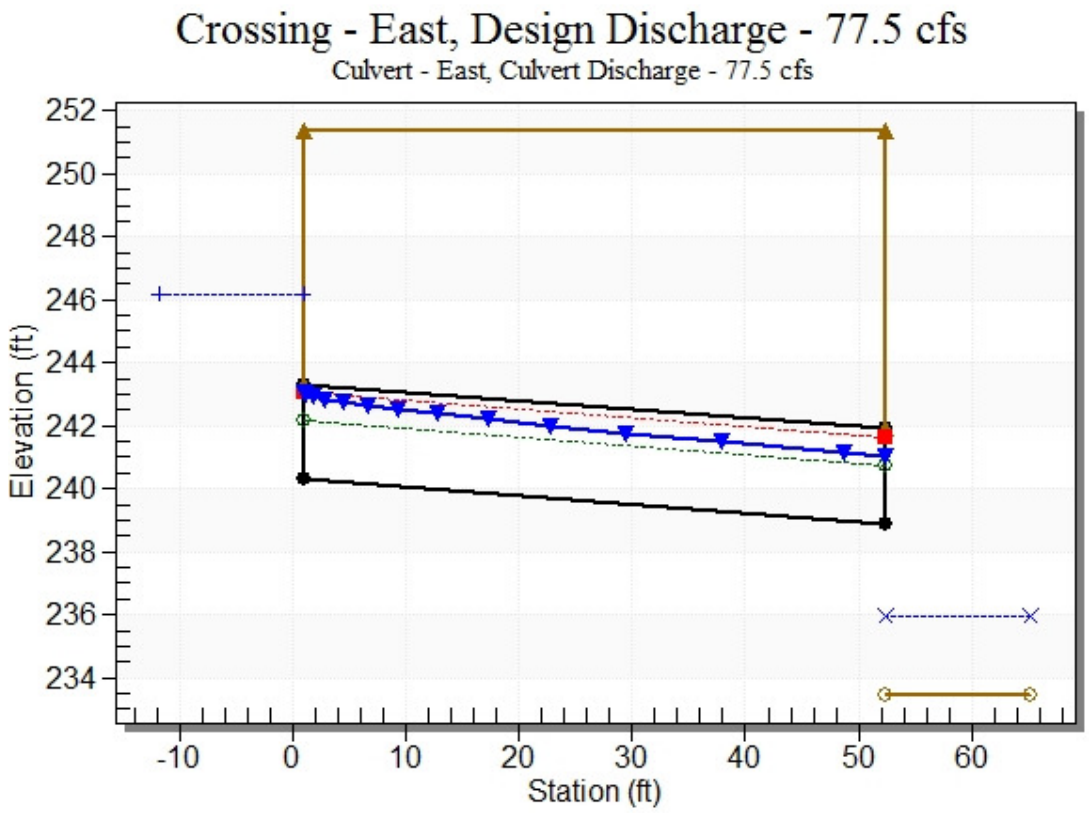
Table 2 - Culvert Summary Table: East

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	240.30	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
10.00	10.00	241.64	1.336	0.0*	1-S2n	0.601	0.997	0.639	1.139	8.985	4.173
20.00	20.00	242.30	2.004	0.231	1-S2n	0.861	1.436	0.942	1.484	10.485	4.989
30.00	30.00	242.84	2.538	0.808	1-S2n	1.067	1.769	1.195	1.738	11.408	5.528
40.00	40.00	243.35	3.047	1.438	5-S2n	1.245	2.057	1.418	1.945	12.161	5.942
50.00	50.00	243.92	3.618	2.469	5-S2n	1.416	2.298	1.626	2.113	12.784	6.354
60.00	60.00	244.60	4.304	3.106	5-S2n	1.576	2.500	1.819	2.266	13.387	6.714
70.00	70.00	245.43	5.127	3.819	5-S2n	1.736	2.657	2.002	2.408	13.988	7.029
77.50	77.50	246.14	5.838	4.403	5-S2n	1.855	2.746	2.133	2.508	14.430	7.241
90.00	90.00	247.49	7.190	5.473	5-S2n	2.064	2.842	2.340	2.667	15.244	7.561
100.00	100.00	248.71	8.410	6.304	5-S2n	2.245	2.650	2.455	2.787	16.150	7.792

* Full Flow Headwater elevation is below inlet invert.

HY-8 Culvert Analysis Report

Water Surface Profile Plot for Culvert: East



Site Data - East

Site Data Option: Culvert Invert Data

Inlet Station: 1.00 ft

Inlet Elevation: 240.30 ft

Outlet Station: 52.40 ft

Outlet Elevation: 238.90 ft

Number of Barrels: 1

Culvert Data Summary - East

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: NONE

HY-8 Culvert Analysis Report

Tailwater Channel Data - East

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0707

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	241.94	0.0600
2	14.60	241.39	0.0600
3	19.20	240.44	0.0600
4	23.70	235.44	0.0600
5	26.00	234.53	0.0600
6	27.90	233.47	0.0600
7	29.90	234.52	0.0600
8	33.10	240.59	0.0600
9	36.90	242.09	0.0600
10	52.50	242.42	0.0000

Roadway Data for Crossing: East

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	251.39
1	23.70	250.51
2	38.80	250.00
3	59.40	249.43
4	72.40	249.16

Roadway Surface: Paved

Roadway Top Width: 51.40 ft

HY-8 Culvert Analysis Report

Table 3 - Summary of Culvert Flows at Crossing: West

Headwater Elevation (ft)	Total Discharge (cfs)	West Discharge (cfs)	Roadway Discharge (cfs)	Iterations
242.30	0.00	0.00	0.00	1
243.78	12.00	12.00	0.00	1
244.53	24.00	24.00	0.00	1
245.15	36.00	36.00	0.00	1
245.80	48.00	48.00	0.00	1
246.61	60.00	60.00	0.00	1
247.62	72.00	72.00	0.00	1
247.71	73.00	73.00	0.00	1
248.51	96.00	81.10	14.79	6
248.62	108.00	82.08	25.75	5
248.70	120.00	82.89	37.05	5
248.21	78.15	78.15	0.00	Overtopping

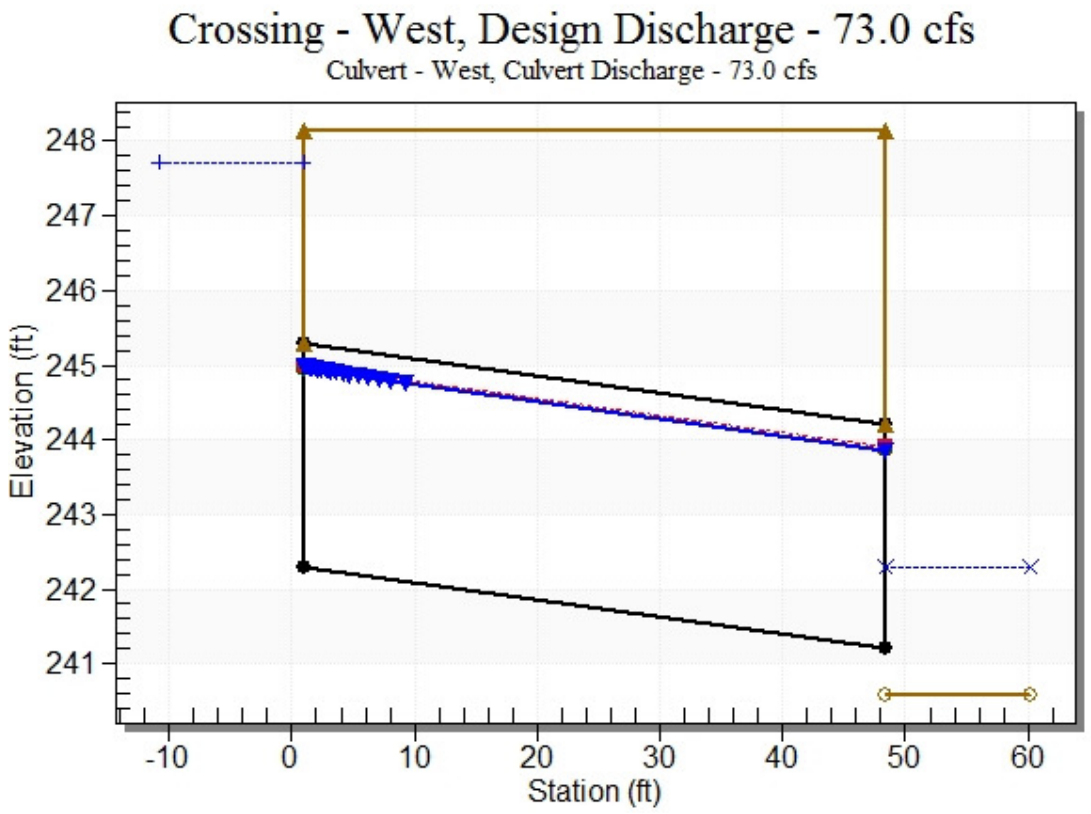
HY-8 Culvert Analysis Report

Table 4 - Culvert Summary Table: West

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	242.30	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
12.00	12.00	243.78	1.481	0.081	1-S2n	0.840	1.095	0.849	0.673	7.319	3.336
24.00	24.00	244.53	2.234	0.822	1-S2n	1.210	1.577	1.237	0.965	8.718	4.127
36.00	36.00	245.15	2.846	1.623	1-S2n	1.528	1.947	1.565	1.191	9.651	4.647
48.00	48.00	245.80	3.502	2.907	5-S2n	1.831	2.253	1.873	1.381	10.342	5.043
60.00	60.00	246.61	4.310	3.807	5-S2n	2.149	2.500	2.185	1.547	10.878	5.366
72.00	72.00	247.62	5.315	4.849	5-S2n	2.589	2.683	2.589	1.690	11.135	5.679
73.00	73.00	247.71	5.408	4.942	5-S2n	2.644	2.696	2.644	1.701	11.097	5.704
96.00	81.10	248.51	6.213	5.718	7-M2c	3.000	2.778	2.778	1.946	11.870	6.200
108.00	82.08	248.62	6.316	5.824	7-M2c	3.000	2.790	2.790	2.062	11.982	6.423
120.00	82.89	248.70	6.403	5.916	7-M2c	3.000	2.797	2.797	2.173	12.080	6.626

HY-8 Culvert Analysis Report

Water Surface Profile Plot for Culvert: West



Site Data - West

Site Data Option: Culvert Invert Data

Inlet Station: 1.00 ft

Inlet Elevation: 242.30 ft

Outlet Station: 48.40 ft

Outlet Elevation: 241.20 ft

Number of Barrels: 1

Culvert Data Summary - West

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0190

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: NONE

HY-8 Culvert Analysis Report

Table 6 - Downstream Channel Rating Curve (Crossing: West)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	240.59	0.00	0.00	0.00	0.00
12.00	241.26	0.67	3.34	2.02	0.82
24.00	241.56	0.97	4.13	2.89	0.86
36.00	241.78	1.19	4.65	3.57	0.88
48.00	241.97	1.38	5.04	4.14	0.90
60.00	242.14	1.55	5.37	4.63	0.91
72.00	242.28	1.69	5.68	5.06	0.92
73.00	242.29	1.70	5.70	5.10	0.92
96.00	242.54	1.95	6.20	5.83	0.93
108.00	242.65	2.06	6.42	6.18	0.94
120.00	242.76	2.17	6.63	6.51	0.94

Tailwater Channel Data - West

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0480

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	247.87	0.0600
2	10.50	246.65	0.0600
3	17.40	245.51	0.0600
4	23.70	242.14	0.0600
5	28.60	240.59	0.0600
6	33.20	240.72	0.0600
7	34.40	242.80	0.0600
8	46.40	244.50	0.0600
9	50.50	245.46	0.0600
10	65.30	249.35	0.0000

Roadway Data for Crossing: West

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	248.15
1	10.40	248.21
2	35.70	248.36
3	43.70	248.50
4	58.70	248.75

Roadway Surface: Paved

Roadway Top Width: 47.40 ft